INSTRUCTION MANUAL

REGULATED POWER SUPPLIES

MODELS
LGS-EE-5-D-OV-R — LGS-EE-28-D-OV-R

MP MASTER
MA28635

LAMBDA

LAMBDA ELECTRONICS MELVILLE, L. I., N. Y.

INSTRUCTION MANUAL

FOR

REGULATED POWER SUPPLIES

MODELS
LGS-EE-5-D-OV-R — LGS-EE-28-D-OV-R

This manual provides instructions intended for the operation of Lambda power supplies, and is not to be reproduced without the written consent of Lambda Electronics. All information contained herein applies to models LGS-EE-5-D-OV-R through LGS-EE-28-D-OV-R unless otherwise specified.

LAMBDA ELECTRONICS MELVILLE, L.I., N.Y.
MAIN PLANT TELEPHONE: 516 MYrtle 4-4200

IM-LGS-EED

TABLE OF CONTENTS

Section	Page
SPECIFICATIONS AND FEATURES	1
THEORY OF OPERATION	4
OPERATING INSTRUCTIONS	6
Basic Mode of Operation	6
Connections for Operation	6
Supply Load Connections	6
Operation After Protective Device Shutdown	7
MAINTENANCE	8
General	8
Trouble Analysis	8
Checking Transistors and Capacitors	8
Printed Circuit Board Maintenance Techniques	8
Trouble Chart	9
Performance Checks	11
Adjustment of Calibration Control R125	11
SERVICE	12
PARTS ORDERING	12

DC OUTPUT — Voltage regulated for line and load. See table I for voltage and current ratings.

TABLE I
VOLTAGE AND CURRENT RANGES

MODELS	VOLTAGE RANGE	MAXIMUM CURRENT (AMPS) AT AMBIENT TEMPERATURE			
		40°C	50°C	60°C	71°C
LGS-EE-5-D-OV-R	5 ± 5%	90.0	85.0	73.0	54.0
LGS-EE-6-D-OV-R	6 ± 5%	78.0	67.0	56.0	42.5
LGS-EE-12-D-OV-R	12 ± 5%	39.0	33.5	28.0	21.0
LGS-EE-15-D-OV-R	15 ± 5%	32.0	28.0	23.5	17.5
LGS-EE-20-D-OV-R	20 ± 5%	26.0	22.5	18.5	14.0
LGS-EE-24-D-OV-R	24 ± 5%	21.5	18.5	15.5	11.5
LGS-EE-28-D-OV-R	28 ± 5%	19.5	17.0	14.0	10.5

Current range must be chosen to suit the appropriate maximum ambient temperature. Current ratings apply for entire voltage range.

REGULATED VOLTAGE OUTPUT

Regulation ..... 0.1% line or load with input variations from 44-58 or 58-44 volts DC and load variations from no load to full load.

Ripple and Noise ..... 10mV RMS, 35mV peak-to-peak for LGS-EE-5-D-OV-R, -6-D-OV-R models; 15mV RMS, 100mV peak-to-peak for LGS-EE-12-D-OV-R, -15-D-OV-R, -20-D-OV-R, -24-D-OV-R, and -28-D-OV-R with either positive or negative terminal grounded.

Temperature Coefficient ..... Change in output voltage 0.03%/°C max.

Remote Programming

External Resistor ..... Nominal 1000 ohms/volt output.

Programming Voltage ..... One-to-one voltage change.

Remote Sensing ..... Provision is made for remote sensing to eliminate effect of power output lead resistance on DC regulation.

OVERSHOOT — No overshoot under conditions of power turn-on, turn-off, or power failure.

DC INPUT - 44 - 58 VDC. Input power: 750 Watts*. Input current: 17.0 Amps**

*With output loaded to full current rating.

**With output loaded to full current rating and input voltage 44VDC.

INPUT FUSE — Fuse F1 protects the input wiring to the power supply. Overload of power supply does not cause fuse failure.

INPUT SURGE PROTECTION — Automatic electronic circuit shuts down inverter operation protecting the power supply against excessive input voltage of up to 100VDC. Input surge protection trip-point is between 65 and 75 volts DC.

INPUT POLARITY PROTECTION — Models LGS-EE-5-D-OV-R through LGS-EE-28-D-OV-R are protected against reversal of input polarity.

OVERLOAD PROTECTION

Thermal ..... Thermostat resets automatically when overtemperature condition is eliminated.

Electrical ..... Automatic electronic current limiting circuit, limits output current to a preset safe value. Automatic current limiting protects the load and power supply when external overloads and direct shorts occur.

OVERVOLTAGE PROTECTION — All LGS-EE models include fixed built-in overvoltage protection circuits which prevent damage to the load caused by excessive power supply output voltage. See table below for overvoltage protector firing ranges.

MODEL	OVERVOLTAGE PROTECTOR TRIP-POINT RANGE (VOLTS)
LGS-EE-5-D-OV-R	6.4 — 6.8
LGS-EE-6-D-OV-R	7.1 — 7.5
LGS-EE-12-D-OV-R	13.3 — 14.1
LGS-EE-15-D-OV-R	16.5 — 17.5
LGS-EE-20-D-OV-R	22.1 — 23.5
LGS-EE-24-D-OV-R	26.5 — 28.1
LGS-EE-28-D-OV-R	30.9 — 32.9

INPUT CONNECTIONS — Terminal block on rear of chassis.

OUTPUT CONNECTIONS — 1/4 - 28 studs on rear of chassis.

OPERATING AMBIENT TEMPERATURE RANGE AND DUTY CYCLE — Continuous duty from 0°C to 71°C ambient with corresponding load current ratings for all modes of operation.

STORAGE TEMPERATURE (non operating) — -55°C to 85°C

FUNGUS — All LGS-EE power supplies are fungus inert.

VDC ADJ. Control — Voltage adjust control permits adjustment of DC output over entire operating range.

PHYSICAL DATA

Size	7-1/2" x 4-15/16 x 16-1/2"
Weight	26 lbs. net; 31 lbs.-shipping
Finish	Gray, FED. STD. 595 No. 26081

MOUNTING — One surface with tapped mounting holes can be utilized for mounting this unit. LGS-EE power supplies must be mounted with Top facing up. Top must be in a horizontal plane. Refer to figure 10 for mounting details.

ACCESSORIES

Rack adapters	Rack adapter LRA-11, used for ruggedized mounting with or without chassis slides, is available.

GENERAL

The Lambda power supply consists of an input circuit; an auxiliary rectifier and filter; a main output rectifier; and a main regulator circuit consisting of timing oscillator, flip-flop, comparator, nor gates, control and current limit amplifiers, and pulse width modulated inverter.

The circuit arrangement is shown in block diagram form in figure 8. The circuitry is discussed with reference to the block diagram and the schematic diagram.

FUNCTIONAL DESCRIPTION

Input Circuit

DC input power is applied to the logic circuitry and to the pulse width modulated inverter via E.M.I. suppression network C29, C18, C20, C21, C16, C27, C28, L3, L4. Fuse F1 protects the power supply against excessive currents due to internal failure.

Pulse Width Modulated Inverter

Positive and negative pulses are provided to the primary of T1 by the alternate conduction of switching transistors Q1, Q3, Q5 and Q2, Q4, Q6. The duration of these pulses is determined by the conduction time of the switching transistors. This time is determined by the duration of drive pulses applied to the bases of Q103 and Q104 by IC103.

When Q103 is turned on turning on Q101, voltage will be applied to the bases of Q1, Q3, Q5 via R103, CR114, and R33 turning Q1, Q3, Q5 on. Diode CR118 prevents saturation of Q1, Q3, Q5 which would extend turn-off time. When Q103 is turned off, Q1, Q3, Q5 turn off.

A similar sequence of events serves to turn Q2, Q4, Q6 on and off as Q104 is turned on and off.

Output Circuit

Positive and negative pulses supplied by T1 secondary are rectified by full wave rectifiers CR1 through CR4 filtered by filter network C3, L1; and supplied to the output via E.M.I. suppression network C8, C9, C13, C14, L2, L9, L10, L11, L12.

Logic and Control Circuits

IC101 is a free running timing oscillator. The output, pin 3, of IC101 is high for 25 microseconds and low for 3 microseconds resulting in an overall period of 28 microseconds. The output of IC101 is fed into flip-flop IC102. IC102 is triggered by the leading edge of the IC101 output resulting in square waves having periods of 56 microseconds at the Q and $\overline{Q}$ (pins 1 and 2) outputs of IC102. Each square wave serves as one input to one of two nor gates located within IC103. The other input of each gate is provided by internal circuitry within IC103 connected as an amplitude comparator at pin 1 of IC103. Pin 1 of IC103 is controlled by the output of the hybrid control amplifier HC101.

HC101 control output is determined by changes in the output voltage as sensed via L7, voltage control R19 and resistor R119. If the output voltage tends to decrease, current from pin 6 output of HC101 is delayed thereby delaying the charging of C119 and delaying the high input to pin 1 of IC103. This action delays turning off the drive output to Q103 or, as applicable, Q104. When IC101 pin 3 goes low, the voltage at IC103 pin 1 is reset via CR126. The connection from IC101 pin 3 to IC103 pins 5 and 6 via CR127 serves to prevent Q103 and Q104 from being turned on while the timing oscillator is in the low state. This sequence of events is shown in the following truth table:

IC101	IC102		IC103			
TIMING OSCILLATOR	FLIP-FLOPS OUTPUTS		INPUT	DRIVE OUTPUTS		REMARKS
Pin 3	Pin 1	Pin 2	Pin 1	Pin 10	Pin 11	
low	low	high	low	low	low	inverter dead period
high	low	high	low	high	low	drive Q103
high	low	high	high	low	low	inverter quiescent period
low	high	low	low	low	low	inverter dead period
high	high	low	low	low	high	drive Q104
high	high	low	high	low	low	inverter quiescent period
low	low	high	low	low	low	inverter dead period

Current Limit Operation

As the load current tends to increase, the inverter current increases, thereby increasing the voltage across R120 via current transformer T2. This voltage is sensed by hybrid control amplifier HC101. The result is the progressive hastening of the current output from HC101 pin 6 and therefore, drive current to Q103 or, as applicable, Q104 is turned off sooner and sooner until the conduction time of the inverter becomes less than 3 microseconds.

As HC101 goes into current limit mode, it begins to draw current at pin 8 via resistors R121 and R122, turning on Q105. This, in turn, turns on Q106. This effectively places C112 in parallel with C118 decreasing the frequency of timing oscillator IC101. This action serves to further limit the output current.

As load impedance approaches a short circuit the load current is held relatively constant.

Overvoltage Circuit Operation

When the output voltage reaches the trip-point of the hybrid overvoltage module, the module fires crow-barring the output of the supply. The current through the module is sensed by current sensor L8. The output of L8 triggers SCR101, crow-barring the logic circuitry and turning the inverter off.

Input Surge Circuit Operation

When input voltage reaches zener breakdown voltage of CR107 (approximately 56 volts) plus reference voltage of HC101 (approximately 7 volts) CR107 begins to conduct. This is sensed by HC101 at pins 4 and 13. When input voltage reaches the trip point level (between 65 and 75 volts), HC101 will shut down inverter operation.

Input Polarity Circuit Operation

If input polarity is reversed, CR5 will conduct, effectively short circuiting the input. This will cause F1 to open.

BASIC MODE OF OPERATION

This power supply operates as a constant voltage source provided the load current does not exceed the rated value at 40°C. For continuous operation, load current must not exceed the rating for each ambient temperature. When the 40°C current rating is exceeded, voltage decreases towards zero and the current at short circuit is held to a safe value.

CONNECTIONS FOR OPERATION

NOTE: Make all connections to the unit before applying input power.

Ground Connections. The Lambda power supply can be operated either with negative or positive output or input terminal grounded. Both positive and negative output ground connections are shown in the diagrams for all suggested connections illustrated in this manual.

Connection Terminals. Make all connections to the supply at the terminal block on the rear of the supply. Apply input power to terminals 1 and 2; always connect the positive lead to terminal 1.

The supply positive output terminal is brought out to terminal 6. The supply negative output terminal is brought out to terminal 4. Recommended wiring of the power supply to the load and selection of wiring is shown in figures 1 through 9. Selection of proper wiring is made on the basis of load requirements. Make all performance checks and measurements of current or voltage at the rear output terminals. Connect measuring devices directly to terminals or use the shortest leads possible.

SUPPLY LOAD CONNECTIONS

Connections for Operation as a Constant Voltage Source

The output impedance and regulation of the power supply at the load may change when using the supply as a constant voltage source and connecting leads of practical length are used. To minimize the effect of the output leads on these characteristics, remote sensing is used. Recommended types of supply-load connections with local or remote sensing are described in the following paragraphs.

Refer to figure 1 to determine voltage drop for particular cable length, wire size and current conditions. Lead lengths must be measured from supply terminals to load terminals as shown in figure 2.

Local Sensing Connection, Figure 3. Local sensing is the connection suitable for application with relatively constant load or for applications with short power output leads.

Remote Sensing Connection, Figure 4. Remote sensing provides complete compensation for the DC voltage drops in the connecting cables. Sensing leads should be a twisted pair to minimize AC pick-up. A 2.5 mf elect., capacitor may be required between output terminals and sense terminals to reduce noise pick-up.

Programmed Voltage Connections, Using External Resistor, Figure 5. Discrete voltage steps can be programmed with a resistance voltage divider valued at a nominal 1000 ohms/volt change and a shorting-type switch as shown in figure 5. When continuous voltage variations are required, use a variable resistor with the same 1000 ohms/volt ratio in place of the resistive voltage divider and shorting-type switch. Use a low temperature coefficient resistor to assure most stable operation.

Before programming, adjust programming resistor for zero resistance and set voltage adjust control to the minimum rated output voltage. Output voltage of programmed supply will nominally be minimum output voltage plus 1 volt per 1000 ohms.

As shown in figure 5, voltages can be programmed utilizing either local or remote sensing connections, as desired.

Programmed Voltage Connections Using Programming Voltage, Figure 6. The power supply voltage output can be programmed with an externally connected programming power supply. The output voltage change of the programmed supply will maintain a one-to-one ratio with the voltage of the programming supply. If the output voltage control of the programmed supply is set to minimum output voltage, output voltage of the programmed supply will be minimum output voltage plus voltage of programming supply.

The programming supply must have a reverse current capability of 1 ma. minimum.

Alternatively, when supplies with less than 1 ma. reverse current capability are used, a resistor capable of drawing 1 ma. at the minimum programming voltage must be connected across the output terminals of the programming supply. This programming supply must be rated to handle all excess resistor current at the maximum programming voltage.

Connections For Series Operation, Figure 7.

The voltage capability of LGS-EE power supplies can be extended by series operation. Figure 7 shows the connections for either local or remote sensing in a series connection where the voltage control of each unit functions independently to control the output.

A diode, having a current carrying capability equal to or greater than the maximum current rating of the supply, must be used and connected as shown in figure 7. The diode blocking voltage should be at least twice the maximum rated output voltage of the supply. See table I, of SPECIFICATIONS AND FEATURES, for power supply current and voltage ratings.

OPERATION AFTER PROTECTIVE DEVICE SHUTDOWN

Thermostat Shutdown. The thermostat shuts down inverter operation only when the temperature of the transistor heat sink exceeds a maximum safe value. The thermostat will automatically reset when the temperature of the heat sink decreases to a safe operating value.

Fuse Shutdown. Fuse will blow when the maximum rated current value for the fuse is exceeded. Fatigue failure of fuses can occur when mechanical vibrations from the installation combine with thermally induced stresses to weaken the fuse metal. Many fuse failures are caused by a temporary condition and replacing the blown fuse will make the fuse protected circuit operative. F1 will provide protection against reversal of input polarity.

Overvoltage Shutdown. When the power supply output voltage increases above the overvoltage limit, HC1 will short circuit output of the supply and SCR101 will shut down inverter operation. After eliminating the cause(s) for overvoltage, resume operation of the supply by momentarily interrupting the DC input circuit. (refer to TROUBLE SHOOTING CHART)

Input Surge Shutdown. When the input voltage exceeds the trip-point, HC101 will shut down inverter operation. Inverter operation will automatically resume when input voltage falls below the trip-point.

Input Polarity Shutdown. If input polarity is reversed. F1 will open to prevent damage to the power supply.

GENERAL

This section describes trouble analysis routine, calibration and test procedures that are useful for servicing the Lambda power supply. A trouble chart is provided as an aid for the troubleshooter. Refer to the section on SPECIFICATIONS AND FEATURES for the minimum performance standards.

TROUBLE ANALYSIS

Whenever trouble occurs, systematically check all fuses, primary power lines, external circuit elements, and external wiring for malfunction before troubleshooting the equipment. Failures and malfunctions often can be traced to simple causes such as improper jumpers and supply-load connections or fuse failure due to metal fatigue.

Use the electrical schematic diagram and block diagram, figure 8, as an aid to locating trouble causes. The schematic diagram contains various circuit voltages that are averages for normal no load operation. Measure these voltages using the conditions for measurement specified on the schematic diagram. Use measuring probes carefully to avoid causing short circuits and damaging circuit components.

CHECKING TRANSISTORS AND CAPACITORS

Check transistors with an in-circuit transistor checker. If no checker is available, transistors can be checked with an ohmmeter that has a highly limited current capability. Observe proper polarity for PNP or NPN to avoid error in measurement. The forward transistor resistance is low but never ZERO; backward resistance is always higher than the forward resistance.

Do not assume trouble is eliminated when only one part is replaced. This is especially true when one transistor fails, causing other transistors to fail. Replacing only one transistor and turning power on, before checking for additional faulty components could damage the replaced component.

When soldering semi-conductor devices, hold the lead being soldered with a pair of pliers or a commercial heat sink device placed between the component and the solder joint.

NOTE: The leakage resistance obtained from a simple resistance check of a capacitor is not always an indication of a faulty capacitor. In all cases the capacitors are shunted with resistances, some of which have low values. Only a dead short is a true indication of a shorted capacitor.

PRINTED CIRCUIT BOARD MAINTENANCE TECHNIQUES

1. If foil is intact, but not covered with solder, it is a good contact. Do not attempt to cover with solder.

2. Voltage measurements can be made from either side of the board. Use a needle-point probe to penetrate to the wiring whenever a protective coating is used on the wiring. A brass probe can be soldered to an alligator clip adapted to measuring instrument.

3. Always use a heat sink when soldering transistors; a transistor pad with mounting feet is an effective heat sink.

4. Broken or damaged printed wiring is usually the result of an imperfection, strain or careless soldering. To repair small breaks, tin a short piece of hook-up wire to bridge the break, and holding the wire in place, flow solder along the length of wire so that it becomes part of the circuitry.

5. When unsoldering components from the board never pry or force loose the part; unsolder the component by using the wicking process described below:

   a) Select a 3/16 inch tinned copper braid for use as a wick; if braid is not available, select AWG No. 14 or No. 16 stranded wire with 1/2 inch insulation removed.

   b) Dip the wick in liquid rosin flux.

c) Place the wick onto the soldered connection and apply soldering iron onto the wick.

d) When sufficient amount of solder flows onto the wick, freeing the component, simultaneously remove iron and wick.

TROUBLE CHART

The trouble chart is intended as a guide for locating trouble causes and is used along with the schematic diagram.

The operating conditions assumed for the trouble chart are as follows:

a) DC power of proper voltage and frequency is present at input terminals.

b) Either positive or negative terminal is connected to chassis ground.

c) The power supply is connected for constant voltage with local sensing. See schematic; dotted lines indicate jumpers connected for local sensing operation.

SAFETY NOTICE

DANGEROUS VOLTAGES EXIST IN THIS EQUIPMENT. OBSERVE THE USUAL SAFETY PRECAUTIONS WHEN OPERATING OR SERVICING THE EQUIPMENT TO AVOID SHOCK OR INJURY.

TROUBLE SHOOTING CHART

Symptom	Possible Cause	Remedy
1. Zero volts DC output, voltage across C1 reads zero.	Open F1.	Check and replace as necessary. Check input polarity.
2. Same as 1, voltage across C1 is correct, voltage across C104 is zero.	Thermostat S1 closed.	Refer to table 1 of SPECIFICATIONS AND FEATURES for current ratings at given ambient temperature. After allowing time for the power supply to cool, resume operation of the supply.

TROUBLE SHOOTING CHART (Cont.)

Symptom	Possible Cause	Remedy
	SCR101 fired due to OV condition.	Interrupt DC input for 20 seconds. If supply operates normally, a transient has occurred in line or load, check wiring (switches, etc.). If supply fails to reach full output voltage, remove DC input, disconnect +V terminal of HC1, remove load, apply DC power and refer to procedure for: Output Too High "Symptom 4."
	R113 open, CR129 shorted.	Check and replace as necessary.
3. Same as 1, voltage across C1 and C104 are correct.	Q1 through Q6 open.	Check and replace as necessary.
4. Output voltage too high.	Open sense lead.	Check load and load connections, correct as necessary.
	Defective HC101. Open R119, R124, R130, CR122 — CR125.	Check and replace as necessary.
5. Very low output voltage, voltage across C104 reads correct.	R126, R127 open. HC101, SCR101 defective.	Check and replace as necessary.
6. High ripple.	Defective HC101.	Replace as required.

PERFORMANCE CHECKS

Check the ripple and regulation of the power supply using the test connection diagram shown in figure 9. Use suggested test equipment or equivalent to obtain accurate results. Refer to SPECIFICATIONS AND FEATURES for minimum performance standards.

Set the differential meter, DC DVM (John Fluke Model 891A or equivalent) to the selected power supply operating voltage. Check the power supply load regulation accuracy while switching from the no load to load condition. Long load leads should be a twisted pair to minimize AC pick-up.

Use a DC power supply, Lambda model LK-362 or equivalent, to vary the line voltage from 44-58 or 58-44 volts DC and check the power supply line regulation accuracy on the DVM differential meter.

Use a TVM, John Fluke Model 931B or equivalent, to measure rms ripple voltage of the power supply DC output. Use oscilloscope to measure peak-to-peak ripple voltage of the power supply DC output.

ADJUSTMENT OF CALIBRATION CONTROL R125.

Whenever HC101 or R125 is replaced, and voltage and current indications do not reflect maximum ratings, adjust R125 as follows. The adjustment procedure requires that the power supply is removed from associated equipment, is at an ambient temperature of 25-30°C, and is stabilized and not operating.

1. Remove DC input power to the supply.
2. Break seal on wiper of R125 from resistor housing and turn to full CW position.
3. Operate power supply for constant voltage with local sensing connected as shown in figure 3, with no external load, and with DC input of 58 VDC.
4. Turn voltage adjust control until minimum rated output voltage is obtained.
5. Apply load so that output current is 105% of 40°C rating for the unit.
6. Using an oscilloscope, Tektronix 503 or equivalent, observe output voltage while adjusting R125 in CCW direction. Adjust R125 until output ripple increases sharply and oscilloscope pattern changes.
7. After adjustment is completed, remove DC power input to the supply and use glyptol sealant to seal wiper of R125 to resistor housing.
8. After sealing, check setting and repeat adjustment procedure if required.

When additional instructions are required or repair service is desired, contact the nearest Lambda office where trained personnel and complete facilities are ready to assist you.

Please include the power supply model and serial number together with complete details of the problem. On receipt of this information, Lambda will supply service data or advise shipping for factory repair service.

All repairs not covered by the warranty will be billed at cost and an estimate forwarded for approval before work is started.

PARTS ORDERING

Standard components and special components used in the Lambda power supply can be obtained from the factory. In case of emergency, critical spare parts are available through any Lambda office.

The following information must be included when ordering parts:

1. Model number and serial number of power supply and purchase date.
2. Lambda part number.
3. Description of part together with circuit designation.
4. If part is not electronic part, or is not listed, provide a description, function, and location, of the part.

PARTS LIST

The electrical parts located on Lambda models LGS-EE-5D-OV-R — LGS-EE-28D-OV-R are listed here. Parts common to a group of models are listed first. Unique parts of individual models within the group are listed separately, by model, immediately following the group common parts listing.

COMMON PARTS

MODELS LGS-EE-5D-OV-R — LGS-EE-28D-OV-R

CIRC. DESIG.	DESCRIPTION	LAMBDA NO.
C1	Cap., elect., 6,600 mf -10 +75%, 75 vdc	CBS-66-153
C2, C5	Not assigned	
C6	Cap., ceramic, 0.01 mf ±20%, 1,000 vdc	CDL-10-004
C7	Not assigned	
C8	Cap., ceramic, 0.1 mf ±20%, 500 vdc	CDM-10-002
C9	Cap., mylar, 0.47 mf ±10%, 300 vdc	CGM-47-028
C10, C11	Cap., ceramic, 0.02 mf ±20%, 1,400 vdc	CLD-20-003
C12	Cap., elect., 33 mf -10 +75%, 50 vdc	CBP-33-040
C13	Same as C8	
C14	Same as C9	
C15	Not assigned	
C16	Same as C10	
C17	Not assigned	
C18	Cap., elect., 3.3 mf -10 +50%, 250 vdc	CBN-33-027
C19	Same as C8	
C20, C21	Cap., ceramic, 0.001 mf ±20%, 3,000 vdc	CDK-10-014
C24	Cap., elect., 3.9 mf ±10%, 50 vdc	CBN-39-041
C25	Same as C6	
C26	Not assigned	
C27, C28	Cap., ceramic, 0.02 mf ±20%, 1,000 vdc	CDL-20-003
C29	Same as C8	
C101	Not assigned	
C102	Cap., elect., 22 mf -10 +100%, 75vdc	CBP-22-076
C103, C104	Cap., elect., 3.3 mf ±20%, 35 vdc	CBN-33-019
C105 thru C110	Not assigned	
C111	Cap., mylar, 0.022 mf ±10%, 200 vdc	CGL-22-001
C113 thru C116	Not assigned	
C117	Cap., mylar, 0.01 mf ±10%, 200 vdc	CGL-10-002
C118	Cap., mica, 1,800 pf ±2%, 300 vdc	CCK-18-003
C119, C120	Cap., mica, 100 pf ±5%, 500 vdc	CCJ-10-007
C121	Cap., mylar, 0.33 mf ±10%, 80 vdc	CGM-33-012
C122	Not assigned	
C123	Cap., mylar, 0.1 mf ±10%, 200 vdc	CAM-10-012
C124	Cap., mylar, 0.47 mf ±10%, 200 vdc	CGM-47-016
C125, C126	Not assigned	
C127	Cap., mica, 680 pf ±10%, 300 vdc	CCJ-68-006

COMMON PARTS (Cont.)

MODELS LGS-EE-5D-OV-R — LGS-EE-28D-OV-R (Cont.)

CIRC. DESIG.	DESCRIPTION	LAMBDA NO.
C128	Same as C118	
CR5	Rectifier	FBL-00-083
CR6, CR7	Rectifier	FBL-00-138
CR8	Rectifier, zener diode	FBM-Z162
CR101 thru CR106	Rectifier	FBL-00-082
CR107	Rectifier, zener diode	FBM-Z163
CR108	Rectifier	FBL-00-030
CR109 thru CR111	Same as CR101	
CR112, CR113	Not assigned	
CR114	Same as CR101	
CR115	Not assigned	
CR116	Same as CR101	
CR117	Not assigned	
CR118, CR119	Rectifier	FBL-00-105
CR120, CR121	Not assigned	
CR122 thru CR125	Rectifier	FBL-00-103
CR126, CR127	Same as CR101	
CR128	Rectifier, zener diode	FBM-Z113
CR129	Rectifier, zener diode	FBM-Z112
CR130	Not assigned	
CR131 thru CR136	Same as CR101	
F1	Fuse, 30A	FFP-30-000
HC101	Hybrid regulator	FBH-00-002B
IC101	Integrated circuit	FBT-00-042
IC102	Integrated circuit	FBT-00-043
IC103	Integrated circuit	FBT-00-044
L2	Toroid choke, output	TCT-117-017
L3	Choke, EMI	BBA-GSEED -1-1
L4	Choke, EMI	BBA-GSEED -2-1
L5	Not assigned	
L6		
L7	Choke, output sense	BBA-GS5-4
L8	Choke, OV	BBA-GSEE-5
L9 thru L12	Toroid choke, output	TCT-027-003
Q1 thru Q6	Transistor, NPN	FBN-L190
Q101 thru Q104	Transistor, NPN	FBN-L177
Q105	Transistor, PNP	FBN-L118
Q106	Transistor, NPN	FBN-L110
R4	Res., ww, 220 ohms ±3%, 5w	DFR-22-079

COMMON PARTS (Cont.)

MODELS LGS-EE-5D-OV-R — LGS-EE-28D-OV-R (Cont.)

CIRC. DESIG.	DESCRIPTION	LAMBDA NO.
R5, R6	Not assigned	
R7	Res., ww, 15 ohms ±5%, 20 w	DFP-15-048
R8, R11 thru R18, R20 thru R31	Not assigned	
R32, R33	Res., comp., 22 ohms ±10%, ½ w	DEB-2201
R34 thru R39	Not assigned	
R40 thru R51	Res., ww, 0.1 ohm ±5%, 3 w	DLM-10-008
R101, R102	Res., comp., 1,000 ohms ±10%, ½ w	DEB-1021
R103, R104	Res., comp., 56 ohms ±5%, 1 w	DGB-5605
R105, R106	Not assigned	
R107	Res., comp., 47 ohms ±10%, ½ w	DEB-4701
R108	Res., comp., 1,500 ohms ±10%, ¼ w	DCB-1521
R109	Res., comp., 22,000 ohms ±10%, ½ w	DEB-2231
R111	Res., comp., 10,000 ohms ±10%, ¼ w	DCB-1031
R112	Res., comp., 4,700 ohms ±10%, ½ w	DEB-4721
R113	Res., ww, 1,000 ohms ±3%, 7 w	DFS-10-069
R114 thru R116	Not assigned	
R117	Res., film, 15,000 ohms ±5%, ¼ w	DCT-15-062
R118	Res., film, 2,210 ohms ±1%, ¼ w	DCS-22-112
R120	Same as R32	
R121	Res., comp., 47,000 ohms ±10%, ½ w	DEB-4731
R122	Res., comp., 10,000 ohms ±10%, ½ w	DEB-1031
R123	Same as R121	
R124	Not assigned	
R125	Res., var., cermet, 2,000 ohms ±10%, 1 w	DRS-20-018
R126	Res., comp., 2.7 ohms ±10%, ¼ w	DCB-27G1
R127	Res., comp., 100 ohms ±10%, ¼ w	DCB-1011
R128	Same as R122	
R129	Not assigned	
R130	Res., ww, 750 ohms ±5%, 3 w	DFR-75-085
R131	Res., comp., 1,000 ohms ±10%, 1 w	DGB-1021
R132	Same as R112	
R133	Not assigned	
R134, R135	Res., comp., 82 ohms ±10%, ½ w	DEB-8201
S1	Thermostat	FKA-110-026

COMMON PARTS (Cont.)

MODELS LGS-EE-5D-OV-R — LGS-EE-28D-OV-R (Cont.)

CIRC. DESIG.	DESCRIPTION	LAMBDA NO.
SCR101	Rectifier, silicon controlled	FBP-00-045
XF1	Fuseholder	HRM-00-013

UNIQUE PARTS

MODEL LGS-EE-5D-OV-R

C3	Cap., elect., 100,000 mf -10 +50%, 7.5 vdc	CBV-10-003
C4	Cap., ceramic, 0.02 mf ±20%, 1,400 vdc	CDL-20-003
C22, C23	Not assigned	
C112	Cap., mylar, 0.001 mf ±10%, 400 vdc	CGK-10-009
CR1 thru CR4	Rectifier	FBL-00-119
HC1	Hybrid circuit	L-20-OV-5
L1	Filter choke	BBA-LGSEE-5
R1, R2	Not assigned	
R3	Res., comp., 12 ohms ±10%, 1 w	DGB-1201
R9, R10	Res., ww, 25 ohms ±3%, 3 w	DFP-25-023
R19	Res., var., cermet, 5,000 ohms ±10%, 1 w	DRS-50-010
T1, T2	Transformer, package (1 req'd)	ADA-GSEED-5

MODEL LGS-EE-6D-OV-R

C3	Cap., elect., 100,000 mf -10 +50%, 7.5 vdc	CBV-10-003
C4	Cap., ceramic, 0.02 mf ±20%, 1,400 vdc	CDL-20-003
C22, C23	Not assigned	
C112	Cap., mylar, 0.001 mf ±10%, 400 vdc	CGK-10-009
CR1 thru CR4	Rectifier	FBL-00-119
HC1	Hybrid circuit	L-20-OV-6
L1	Filter choke	BBA-LGSEE-5
R1, R2	Not assigned	
R3	Res., comp., 12 ohms ±10%, 1 w	DGB-1201
R9, R10	Res., ww, 25 ohms ±3%, 3 w	DFP-25-023
R19	Res., var., cermet, 5,000 ohms ±10%, 1 w	DRS-50-010
T1, T2	Transformer, package (1 req'd)	ADA-GSEED-6

MODEL LGS-EE-12D-OV-R

C3	Cap., elect., 65,000 mf -10 +50%, 15 vdc	CBT-65-053
C4	Not assigned	
C22, C23	Cap., mica, 2,000 pf ±5%, 500 vdc	CCK-20-005
C112	Cap., mylar, 0.0033 mf ±10%, 200 vdc	CGK-33-003
CR1, CR2	Rectifier	FBL-00-118

UNIQUE PARTS (Cont.)

MODEL LGS-EE-12D-OV-R (Cont.)

CIRC. DESIG.	DESCRIPTION	LAMBDA NO.
CR3, CR4	Not assigned	
HC1	Hybrid circuit	L-20-OV-12
L1	Filter choke	BBA-LGSEE-12
R1, R2	Res., comp., 180 ohms ±10, ½ w	DEB-1811
R3	Not assigned	
R9, R10	Res., ww, 100 ohms ±3%, 5 w	DFR-10-025
R19	Res., var., cermet, 5,000 ohms ±10%, 1 w	DRS-50-010
T1, T2	Transformer, package (1 req'd)	ADA-GSEED-12

MODEL LGS-EE-15D-OV-R

C3	Cap., elect., 55,000 mf -10 +50%, 17.5 vdc	CBT-55-054
C4	Not assigned	
C22, C23	Cap., mica, 2,000 pf ±5%, 500 vdc	CCK-20-005
C112	Cap., mylar, 0.0033 mf ±10%, 200 vdc	CGK-33-003
CR1, CR2	Rectifier	FBL-00-118
CR3, CR4	Not assigned	
HC1	Hybrid circuit	L-20-OV-15
L1	Filter choke	BBA-LGSEE-15
R1, R2	Res., comp., 180 ohms ±10%, ½ w	DEB-1811
R3	Not assigned	
R9, R10	Res., ww, 100 ohms ±3%, 5 w	DFR-10-025
R19	Res., var., cermet, 5,000 ohms ±10%, 1 w	DRS-50-010
T1, T2	Transformer, package (1 req'd)	ADA-GSEED-15

MODEL LGS-EE-20D-OV-R

C3	Cap., elect., 45,000 mf -10 +50%, 25 vdc	CBT-45-055
C4	Not assigned	
C22, C23	Cap., mica, 2,000 pf ±5%, 500 vdc	CCK-20-005
C112	Cap., mylar, 0.0068 mf ±10%, 200 vdc	CGK-68-001
CR1, CR2	Rectifier	FBL-00-118
CR3, CR4	Not assigned	
HC1	Hybrid circuit	L-20-OV-20
L1	Filter choke	BBA-GSEED-20
R1, R2	Res., comp., 180 ohms ±10%, ½ w	DEB-1811
R3	Not assigned	

UNIQUE PARTS (Cont.)

MODEL LGS-EE-20D-OV-R (Cont.)

CIRC. DESIG.	DESCRIPTION	LAMBDA NO.
R9, R10	Res., ww, 150 ohms ±5%, 5 w	DFR-15-109
R19	Res., var., cermet, 10,000 ohms ±10%, 1 w	DRT-10-042
T1, T2	Transformer, package (1 req'd)	ADA-GSEED-20

MODEL LGS-EE-24D-OV-R

C3	Cap., elect., 32,000 mf -10 +50%, 30 vdc	CBT-32-056
C4	Not assigned	
C22, C23	Cap., mica, 2,000 pf ±5%, 500 vdc	CCK-20-005
C112	Cap., mylar, 0.0068 mf ±10%, 200 vdc	CGK-68-001
CR1, CR2	Rectifier	FBL-00-140
CR3, CR4	Not assigned	
HC1	Hybrid circuit	L-20-OV-24
L1	Filter choke	BBA-GSEED-24
R1, R2	Res., comp., 180 ohms ±10%, ½ w	DEB-1811
R3	Not assigned	
R9, R10	Res., ww, 150 ohms ±5%, 5 w	DFR-15-109
R19	Res., var., cermet, 10,000 ohms ±10%, 1 w	DRT-10-042
T1, T2	Transformer, package (1 req'd)	ADA-GSEED-28

MODEL LGS-EE-28D-OV-R

C3	Cap., elect., 32,000 mf -10 +50%, 30 vdc	CBT-32-056
C4	Not assigned	
C22, C23	Cap., mica, 2,000 pf ±5%, 500 vdc	CCK-20-005
C112	Cap., mylar, 0.0068 mf ±10%, 200 vdc	CGK-68-001
CR1, CR2	Rectifier	FBL-00-140
CR3, CR4	Not assigned	
HC1	Hybrid circuit	L-20-OV-28
L1	Filter choke	BBA-GSEED-28
R1, R2	Res., comp., 180 ohms ±10%, ½ w	DEB-1811
R3	Not assigned	
R9, R10	Res., ww, 220 ohms ±3%, 5 w	DFR-22-079
R19	Res., var., cermet, 10,000 ohms ±10%, 1 w	DRT-10-042
T1, T2	Transformer, package (1 req'd)	ADA-GSEED-28

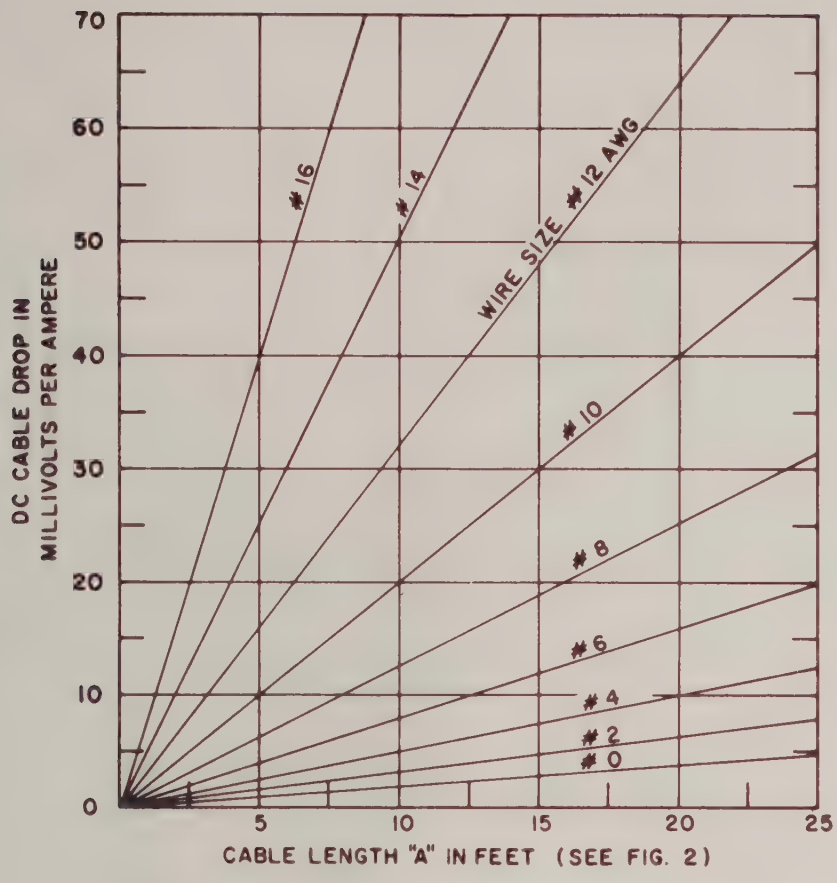


Figure 1. Cable Connection Chart.

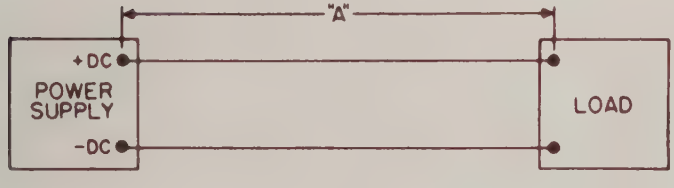


Figure 2. Cable Length "A" In Feet.

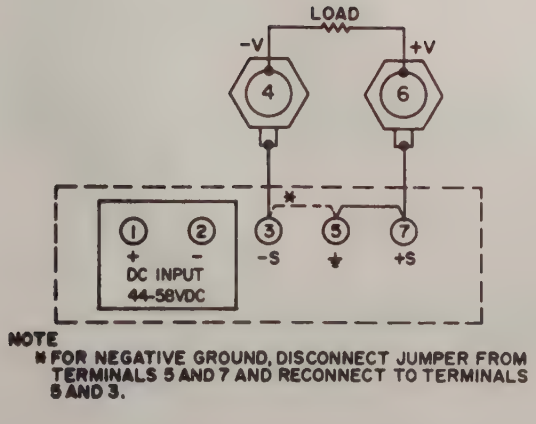


Figure 3. Local Sensing Connections.

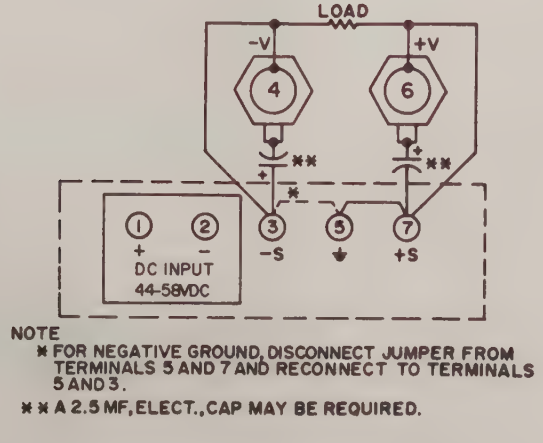
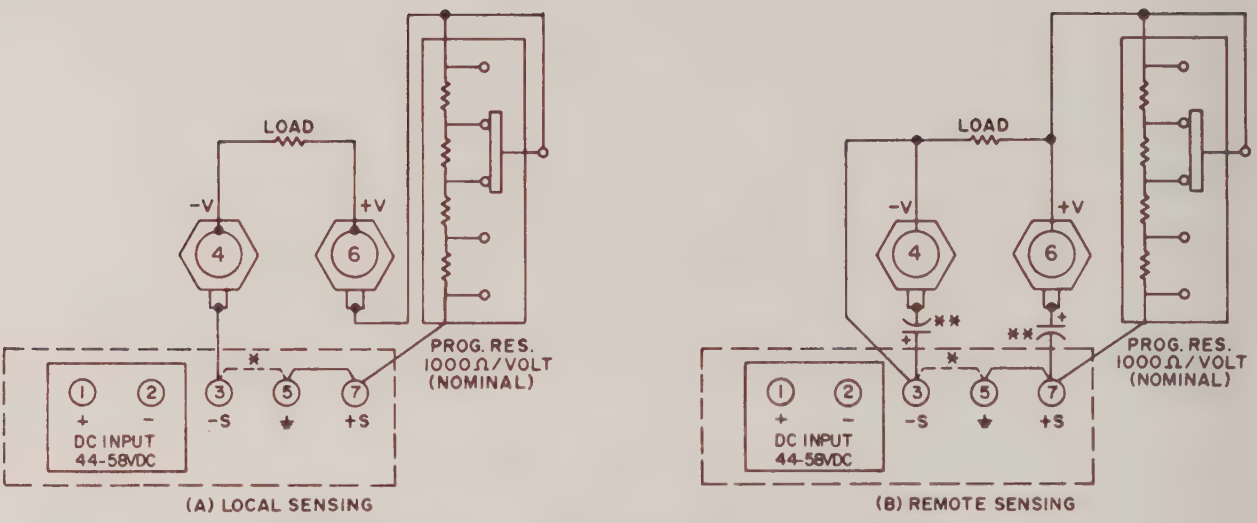
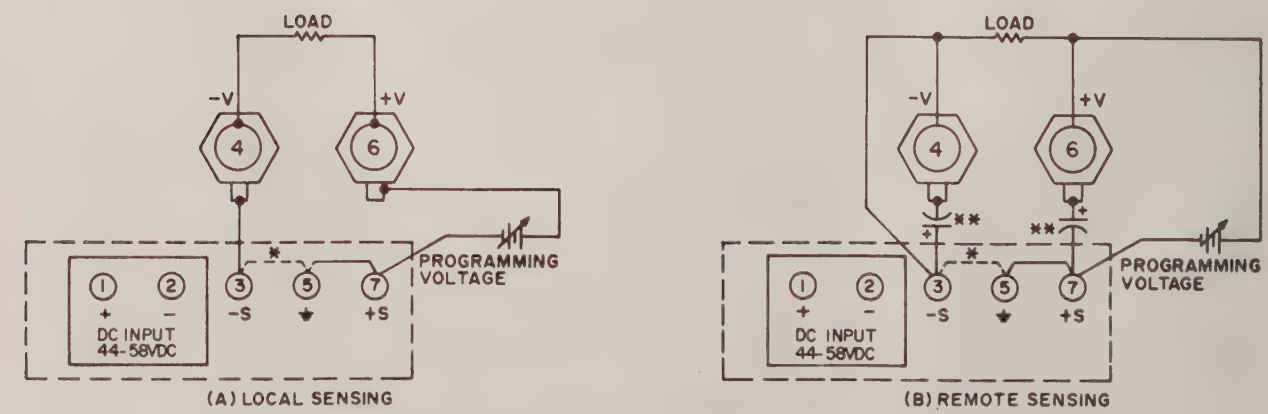


Figure 4. Remote Sensing Connections.



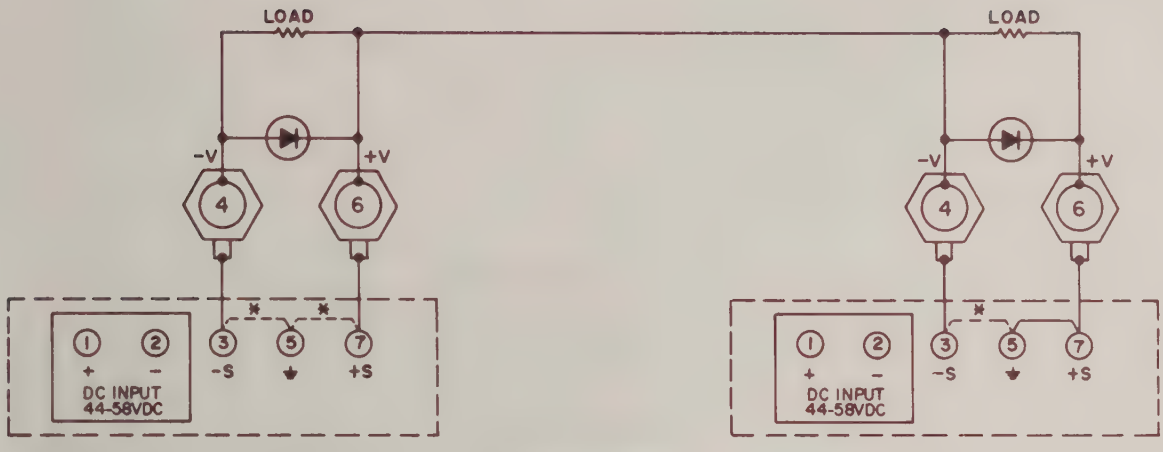
NOTE
* FOR NEGATIVE GROUND, DISCONNECT JUMPER FROM TERMINALS 5 AND 7 AND RECONNECT TO TERMINALS 3 AND 5.
** A 2.5 MF, ELECT., CAP. MAY BE REQUIRED.

Figure 5. Programmed Voltage, With External Resistor.

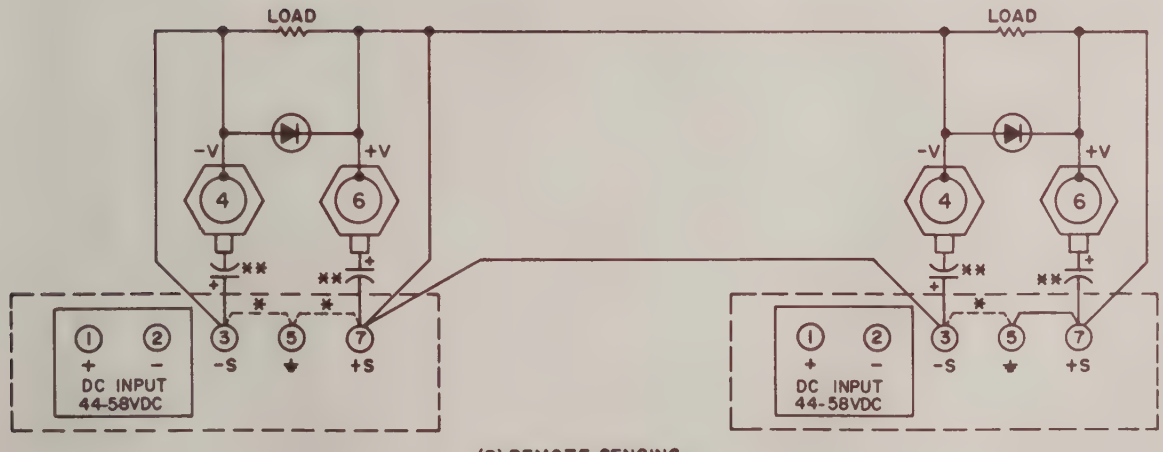


NOTE
* FOR NEGATIVE GROUND, DISCONNECT JUMPER FROM TERMINALS 5 AND 7 AND RECONNECT TO TERMINALS 3 AND 5.
** A 2.5 MF, ELECT., CAP. MAY BE REQUIRED.

Figure 6. Programmed Voltage, With External Programming Voltage Source.



(A) LOCAL SENSING



(B) REMOTE SENSING

NOTE:

* MAKE ONLY ONE GROUND CONNECTION FOR SERIES COMBINATION. TO CHANGE GROUND AS SHOWN, REMOVE JUMPER FROM TERMINALS 5 AND 7 ON RIGHT UNIT AND CONNECT ANY ONE OF THE OTHER JUMPERS AS SHOWN IN DOTTED LINE.

** A 2.5MF, ELECT., CAP. MAY BE REQUIRED.

Figure 7. Series Connection.

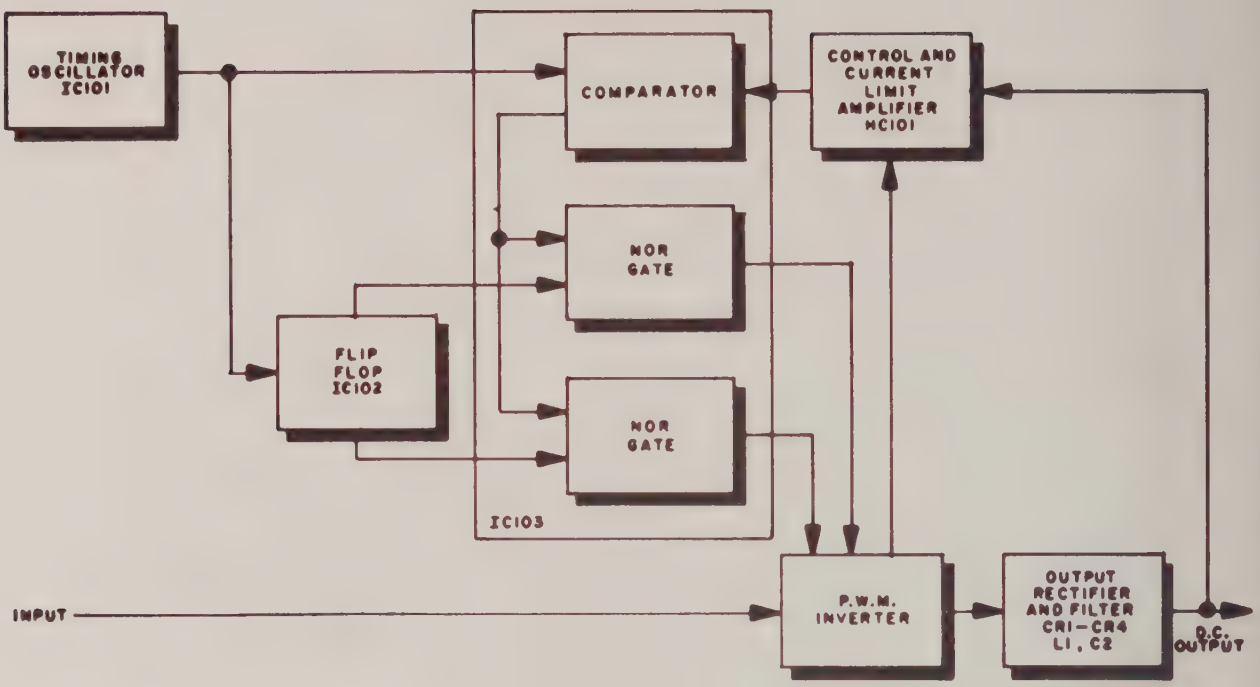
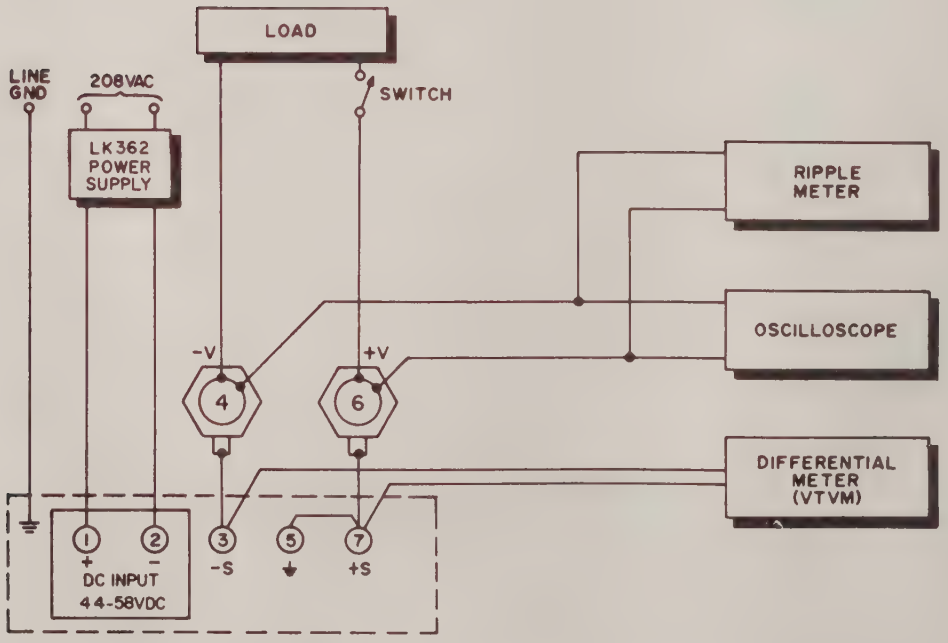


Figure 8. Typical Block Diagram.



NOTES
1. REGULATION AND RIPPLE CHECK METERS MUST NOT BE GROUNDED THROUGH THREE WIRE LINE CORD TO GROUND.
2. PERFORM CHECKS WITH LOCAL SENSING CONNECTION ONLY

Figure 9. Test Connections for Performance Checks.

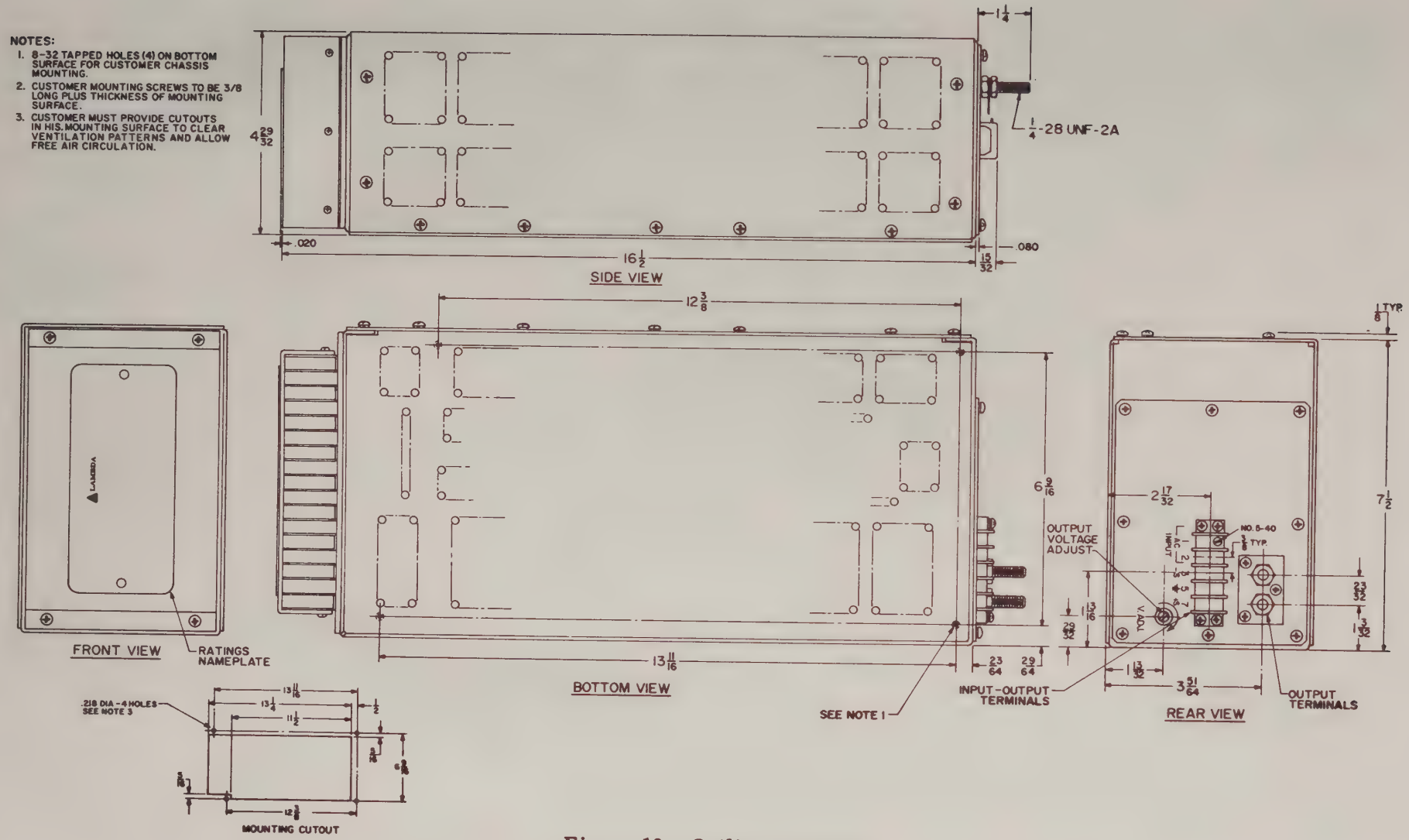
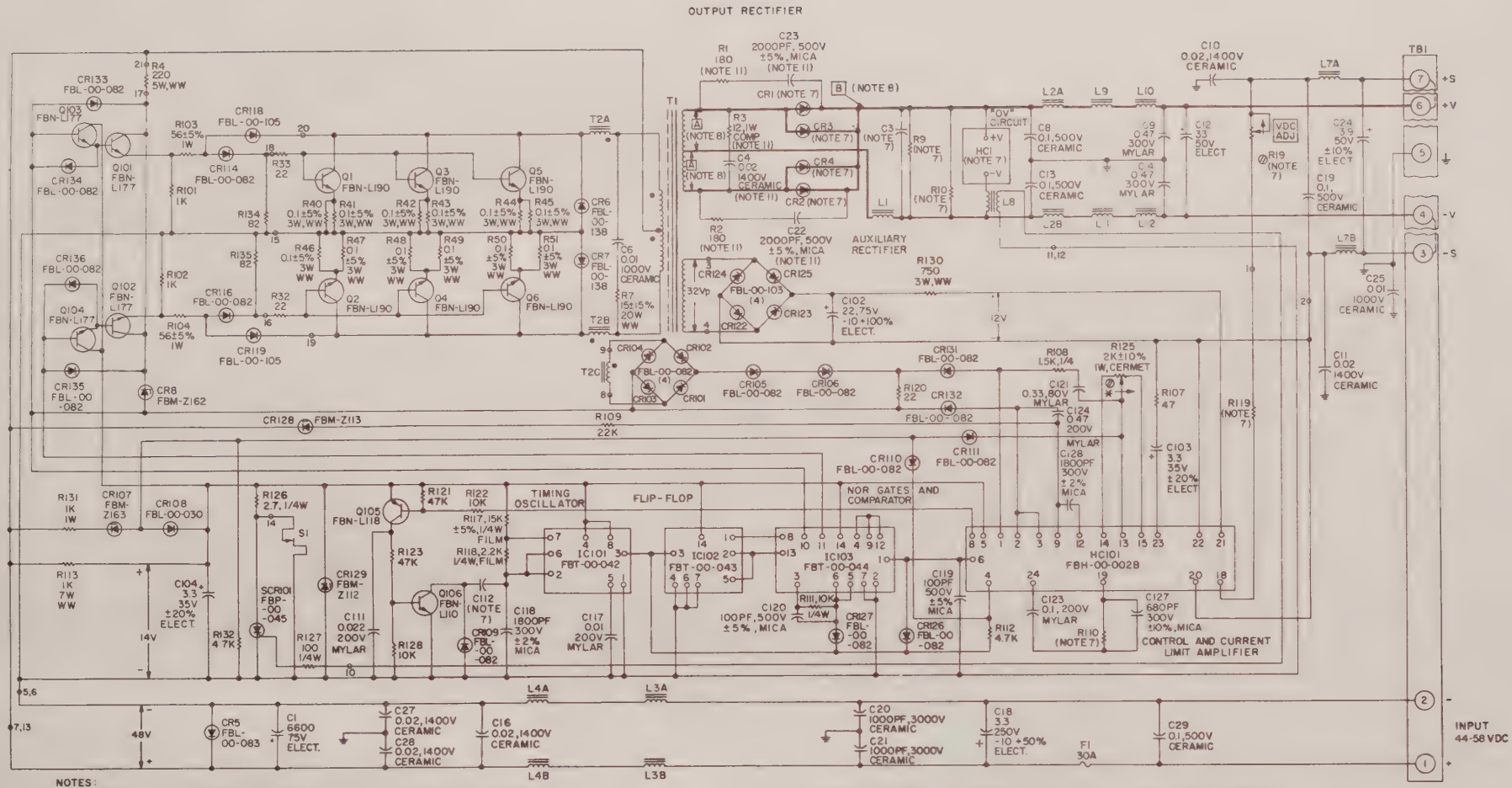
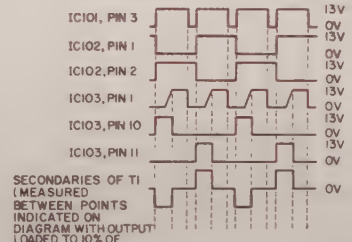

NOTES:
1. 8-32 TAPPED HOLES (4) ON BOTTOM SURFACE FOR CUSTOMER CHASSIS MOUNTING.
2. CUSTOMER MOUNTING SCREWS TO BE 3/8 LONG PLUS THICKNESS OF MOUNTING SURFACE.
3. CUSTOMER MUST PROVIDE CUTOUTS IN HIS MOUNTING SURFACE TO CLEAR VENTILATION PATTERNS AND ALLOW FREE AIR CIRCULATION.
SIDE VIEW
FRONT VIEW
RATINGS NAMEPLATE
BOTTOM VIEW
SEE NOTE 1
REAR VIEW
OUTPUT VOLTAGE ADJUST
INPUT-OUTPUT TERMINALS
OUTPUT TERMINALS
MOUNTING CUTOUT
.218 DIA - 4 HOLES SEE NOTE 3

Figure 10. Outline Drawing.



NOTES:

1. RESISTORS ARE 1/2W COMP. WITH VALUES IN OHMS UNLESS OTHERWISE NOTED.
2. CAPACITOR VALUES ARE IN MICROFARADS UNLESS OTHERWISE NOTED.
3. RESISTOR TOLERANCES: COMP ± 10%, FILM ±1%, WIREWOUND ±3%.
4. CAPACITOR TOLERANCES ELECTROLYTIC -10 +75%, CERAMIC ±20%, MYLAR ± 10%, UNLESS OTHERWISE NOTED.
5. SYMBOLS:
   - ▭ INDICATES ACTUAL UNIT MARKING
   - ↓ INDICATES CLOCKWISE ROTATION OF SHAFT
   - ✱ SEE INSTRUCTION MANUAL.
   - —o— INDICATES TERMINAL ON PRINTED WIRING BOARD OR TERMINAL BOARD.
- ⌀ INDICATES ADJUSTMENT OR CALIBRATION CONTROL.
6. DESIGNATIONS ARE LAMBDA PART NUMBERS.
7. SEE TABLE I FOR COMPONENT VALUES.
8. SEE TABLE I FOR VOLTAGE VALUES.
9. CONDITIONS FOR CIRCUIT POINT MEASUREMENTS: INPUT: 48 VDC OUTPUT: NOMINAL VOLTAGE NO LOAD, +S AND +V SHORTED, -S AND -V SHORTED INDICATED VOLTAGES ARE TYPICAL VALUES AND ARE DC UNLESS OTHERWISE NOTED. DC MEASUREMENTS TAKEN WITH 20,000 OHMS/V VOLTMETER, AC MEASUREMENTS ARE PEAK VALUES MEASURED WITH OSCILLOSCOPE VOLTAGES ARE TAKEN BETWEEN INDICATED POINTS AND -S (TERM. 3) UNLESS OTHERWISE NOTED.
10. THE FOLLOWING WAVEFORMS CAN BE OBSERVED BETWEEN INDICATED POINTS AND CI(-) UNLESS OTHERWISE NOTED


IC101, PIN 3
IC102, PIN 1
IC102, PIN 2
IC103, PIN 1
IC103, PIN 10
IC103, PIN 11
SECONDARIES OF T1 (MEASURED BETWEEN POINTS INDICATED ON DIAGRAM WITH OUTPUT LOADED TO 10% OF RATED CURRENT MINIMUM)
13V
0V

11. C4, R3 ONLY USED ON MODELS LGS-EE-5D-OV-R AND LGS-EE-6D-OV-R C22, C23, R1, R2 NOT USED ON MODELS LGS-EE-5D-OV-R AND LGS-EE-6D-OV-R

FOR WIRING OF POWER SUPPLY TO LOAD REFER TO SUPPLY-TO-LOAD WIRING DIAGRAMS

DOTTED CONNECTIONS SHOWN ON TB1 INDICATE JUMPERS IN PLACE FOR LOCAL SENSING CONNECTION

THIS SCHEMATIC APPLIES TO UNITS BEARING SERIAL NO. PREFIX A

SCHEMATIC DIAGRAM
REGULATED POWER SUPPLY

MODELS
LGS-EE-5D-OV-R
LGS-EE-6D-OV-R
LGS-EE-12D-OV-R
LGS-EE-15D-OV-R
LGS-EE-20D-OV-R
LGS-EE 24D-OV-R
LGS-EE-28D-OV-R

LAMBDA
ELECTRONICS
MELVILLE, NEW YORK
DIVISION OF Veeco INSTRUMENTS INC.

TABLE I
SCHEMATIC DATA REFERENCES
MODELS LGS-EE-5D-OV-R THRU LGS-EE-28D-OV-R

Models	Schematic Voltage Measurements		Schematic Components							
			C3	C112	CR1-CR4**	HC1	R9,R10	R19	R110	R119
	A ($V\rho$)	B (VDC)	-10 +50% ELECT.	±10% MYLAR	FBL-00-*	L-20-OV-*	WW	±10%, 1 W CERMET	±10%, ¼ W COMP	±1%, ¼ W FILM
LGS-EE-5D-OV-R	9.0	5.0	100,000 mf 7.5 vdc	0.001 mf 400 vdc	119	5	25 ±3% 3 W	5K	68K	Jumper
LGS-EE-6D-OV-R	10.0	6.0	100,000 mf 7.5 vdc	0.001 mf 400 vdc	119	6	25 ±3% 3 W	5K	68K	Jumper
LGS-EE-12D-OV-R	20.0	12.0	65,000 mf 15 vdc	0.0033 mf 200 vdc	118	12	100 ±3% 5 W	5K	68K	7.5K
LGS-EE-15D-OV-R	24.0	15.0	55,000 mf 17.5 vdc	0.0033 mf 200 vdc	118	15	100 ±3% 5 W	5K	68K	10K
LGS-EE-20D-OV-R	33.0	20.0	45,000 mf 25 vdc	0.0068 mf 200 vdc	118	20	150 ±5% 5 W	10K	100K	13.3K
LGS-EE-24D-OV-R	38.0	24.0	32,000 mf 30 vdc	0.0068 mf 200 vdc	140	24	150 ±5% 5 W	10K	100K	18.2K
LGS-EE-28D-OV-R	42.0	28.0	32,000 mf 30 vdc	0.0068 mf 200 vdc	140	28	220 ±3% 5 W	10K	100K	20K

*Lambda part no.
**CR3, CR4 only used on models LGS-EE-5D-OV-R and LGS-EE-6D-OV-R.

5 - Year
Guarantee
We warrant each instrument manufactured by us, and sold by us or our authorized agents, to be free from defects in material and workmanship, and that it will perform within applicable specifications for a period of five years after original shipment. Our obligation under this guarantee is limited to repairing or replacing any instrument or part thereof, (except tubes and fuses) which shall, within five years after delivery to the original purchaser, be returned to us with transportation charges prepaid, prove after our examination to be thus defective.
We reserve the right to discontinue instruments without notice, and to make modifications in design at any time without incurring any obligation to make such modifications to instruments previously sold.

LAMBDA ELECTRONICS
515 BROAD HOLLOW ROAD • MELVILLE, L. I., NEW YORK • 516 MYRTLE 4-4200

DIVISION of Veeco INSTRUMENTS INC.

MP MASTER
MA28635

IM-LGS-EED